Space Weather Technical Forecast

Issued on Thursday, 09 December 2021 at 00:43 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight chance of G1/Minor Storms on Days 1 and 2 (09 and 10 Dec).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Very Low over the past 24 hours with no notable flares. There are no sunspots currently on the visible disc. No Earth-directed CMEs have been observed in the past 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind speed, as measured by DSCOVR at L1, has been mainly at slightly elevated levels, with a peak of 456 km/s at 1250 UTC. A subsequent decline in speeds since then has seen winds drop to background levels. Density was initially at average (5-10 ppcc) levels but has become below average. The IMF, Bt, was weak at 6 nT or below, and the north-south component (Bz) varied between +4/-4 nT. The phi angle was predominately positive (away from the Sun). Resultant geomagnetic activity during the period was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at background levels. The high energy electron flux (greater than 2 MeV) was mainly Moderate levels, with a peak of 980 pfu at 08/1640 UTC. The associated 24-hour integrated fluence has been below the Active threshold throughout (1e8 integrated pfu), with 4.26e7 integrated pfu observed at 09/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to stay Very Low during the forecast period in the absence of any sunspot development.

Solar Wind / Geomagnetic Activity: There are two potentially Earth-directed CMEs in the forecast. The first CME may arrive later on Day 1 (9th), but confidence is low. The second CME will likely arrive at Earth as a weak feature on Day 2 (10th). Although initially solar winds will be at background levels, minor fast wind enhancements are possible during Day 1 or 2 from the aforementioned CMEs or influence of CH29 in the sun's northwest quadrant. A more marked enhancement of the solar wind up to slightly elevated levels is more likely on Days 3 and 4 (11th and 12th) due to the expected arrival of the larger CH30 in the sun's southern hemisphere. Quiet Geomagnetic activity is expected to become mainly Unsettled or perhaps Active later on Day 1 and also Day 2, with a slight chance of G1/Minor Storms. Mainly Quiet or Unsettled activity is expected thereafter, with a chance of Active intervals.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at Background levels.
The high energy electron flux (greater than 2 MeV) is likely to be mainly at Moderate or background levels, but perhaps increasing to High on Day 3 or 4 (11th or 12th). The associated 24-hour integrated fluence is expected to persist below the Active threshold.

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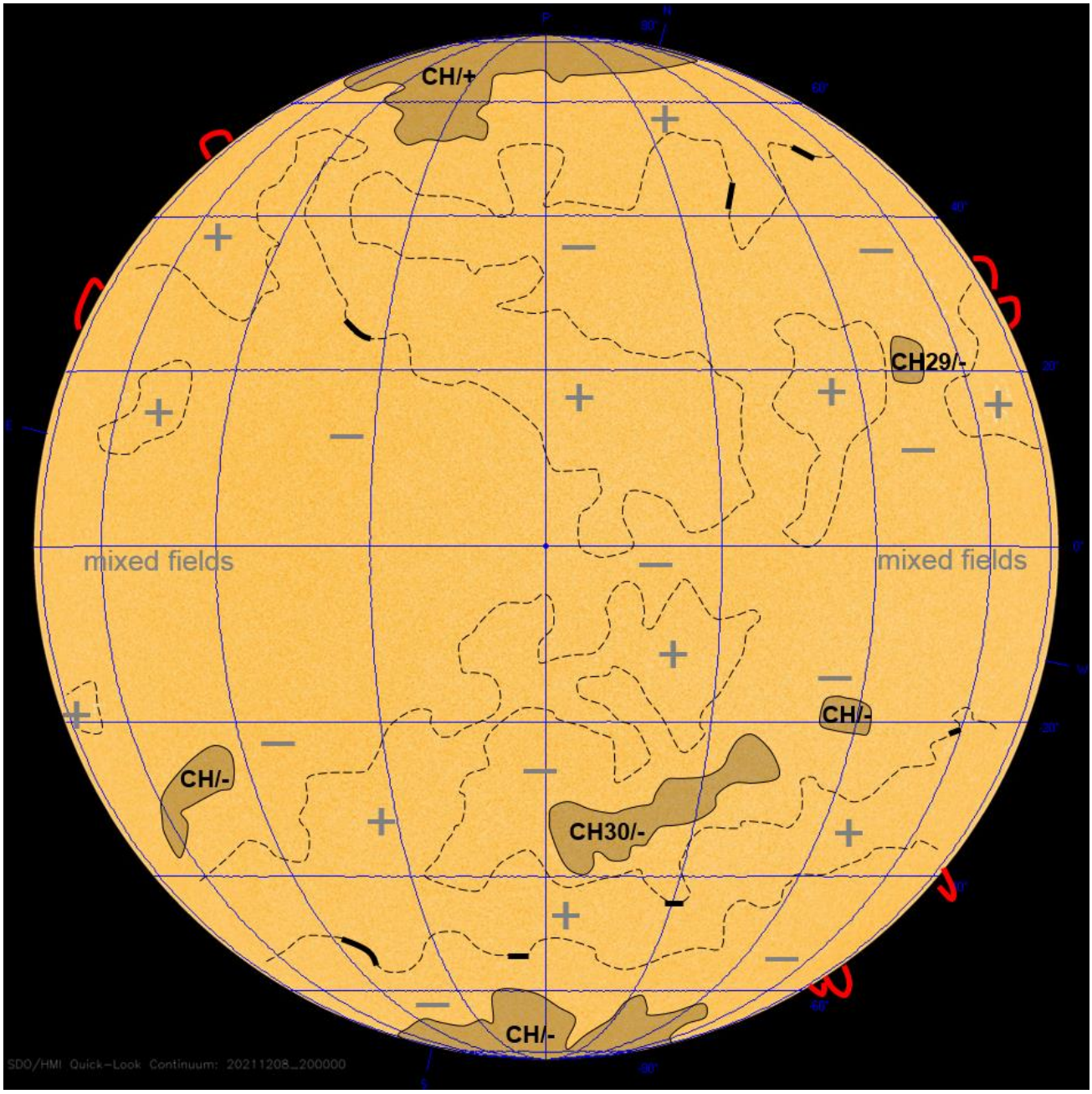
Figure 1. Solar Analysis Valid 08/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are two potentially Earth-directed CMEs in the forecast. The first CME is expected to arrive on Day 1 (9th) at 1800UTC +/-9 hours, but confidence is low. The second CME will likely arrive at Earth as a weak feature on Day 2 (10th) around 0900 UTC +/-12hrs. Although initially solar winds will be at background levels, minor fast wind enhancements are possible during Day 1 or 2 from the aforementioned CMEs or possible influence of CH29 in the sun's northwest quadrant. This coronal hole is very small however, so its influence on earth may be negligible. A more marked enhancement of the solar wind up to slightly elevated levels is more likely on Days 3 and 4 (11th and 12th) due to the expected arrival of the larger CH30 located in the sun's southern hemisphere.

No significant enhancement has been observed at STEREO-A at the time of writing, which is currently ~2.8 days ahead of Earth, but STEREO A is positioned further north than Earth with respect to CH30, so may not connect with this feature.

Quiet Geomagnetic activity is expected to become mainly Unsettled or perhaps Active later on Day 1 and also Day 2, with a slight chance of G1/Minor Storms. Mainly Quiet or Unsettled activity is expected thereafter, with a chance of isolated Active intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	20	10	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
05/2337	Partial	Filament Eruption	South centre disc	325 km/s	09/1800 UTC	Limited shock expected
06/1613	Partial	Filament Eruption	SE quadrant	310 km/s	10/0900 UTC	Limited shock expected

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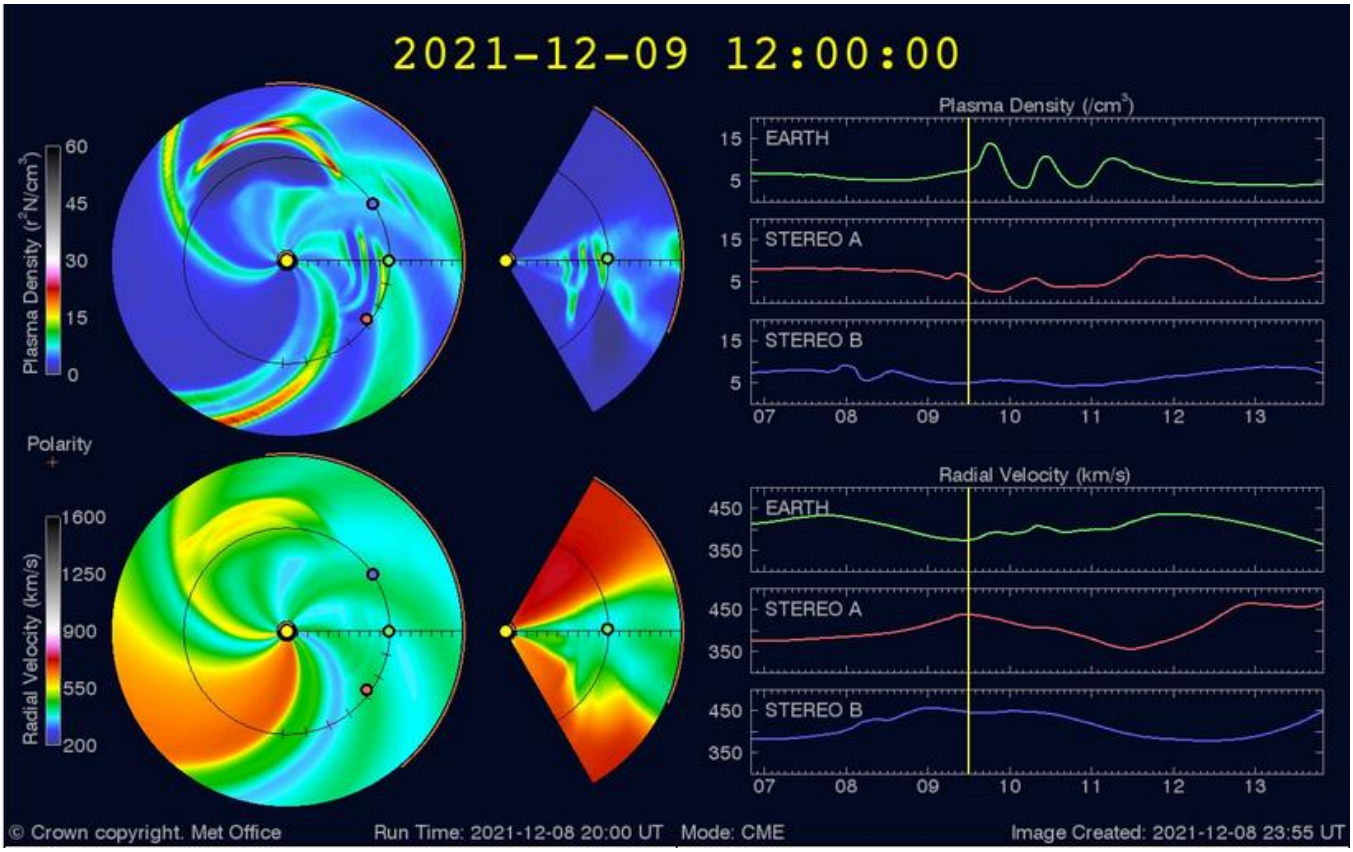
Figure 2: ENLIL showing two potential CME arrivals at Earth on 9th/10th December.



Radio Blackouts - X-Ray Flares:

Solar Activity has been at Very Low levels during the past 24 hours. There are currently no sunspot regions on the visible disc. A small, slightly brighter region showing on STEREO-A EUVI imagery in the southern hemisphere may be a new region to rotate onto the disc towards the end of Day 1 (9th), or may just be plage.

Solar activity is expected to remain Very Low throughout the forecast period in the absence of any sunspot development.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	1	1	1	1
Very Active	R3 to R5 X Class	No	1	1	1	1

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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is forecast to remain at background levels, with no solar radiation storms anticipated.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2 MeV) as observed by GOES-16 is at Moderate levels and is expected to remain at this level during much of if not all of Day 1 (9th). There is the potential for a dropout in electron flux from any geomagnetic activity associated with CMEs and/or CH29 high speed stream arrival either later on Day 1 or during Day 2 (10th). This may be followed by an increase in values on Day 3 and 4 (11th and 12th), as geomagnetic activity subsides, but this carries low confidence and is expected to be small if there is a response, given the anticipated arrival of CH30.

Fluence levels are expected to remain below the Active threshold throughout the forecast period.

REFM output is thought to be offering good guidance in a general downtrend in electron fluence early in the period, though may fall away sooner in response to any CME arrivals on Day 1 or 2, that do not factor into the forecast values.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	10	5	5	10
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

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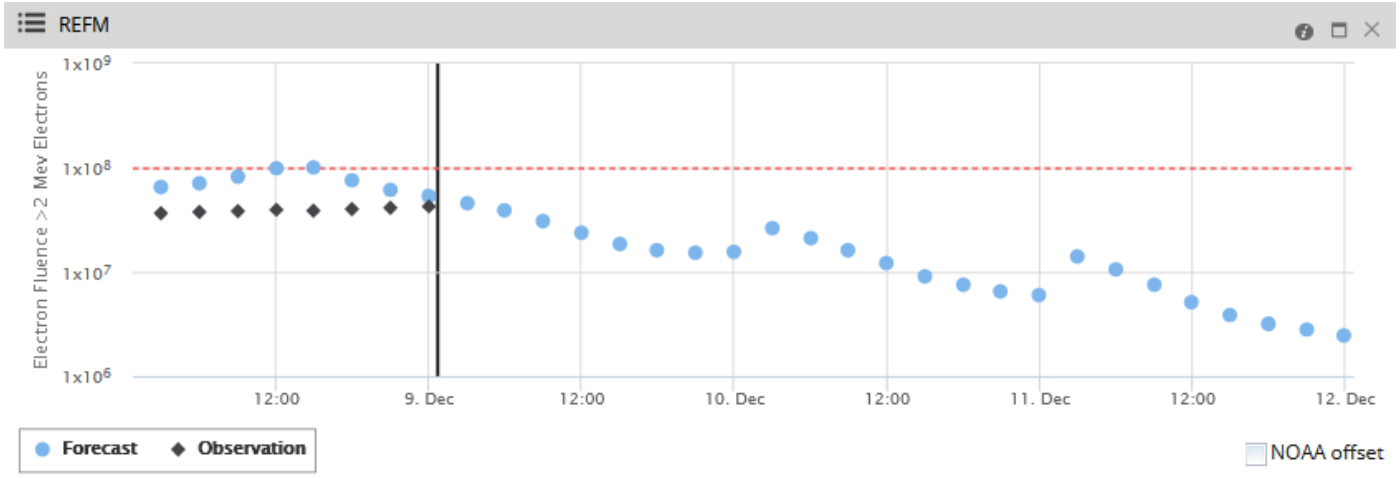
Figure 3: MOSWOC REFM output.



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